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BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Application Number: 10/748,175
Filing Date: December 31, 2003
Appellant(s): TROSMAN ET AL.

Matthew J. Lattig
For Appellant

EXAMINER'S ANSWER

This is in response to the appeal brief filed 9/29/2006 appealing from the Office action mailed 2/13/2006.

(1) Real Party in Interest

A statement identifying by name the real party in interest is contained in the brief.

(2) Related Appeals and Interferences

The following are the related appeals, interferences, and judicial proceedings known to the examiner which may be related to, directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal:

Application Ser. No. 10/748,174.

The Appeal Brief was filed 9/28/2006.

(3) Status of Claims

The statement of the status of claims contained in the brief is correct.

(4) Status of Amendments After Final

The appellant's statement of the status of amendments after final rejection contained in the brief is correct.

(5) Summary of Claimed Subject Matter

The summary of claimed subject matter contained in the brief is correct.

(6) Grounds of Rejection to be Reviewed on Appeal

The appellant's statement of the grounds of rejection to be reviewed on appeal is correct.

(7) Claims Appendix

The copy of the appealed claims contained in the Appendix to the brief is correct.

(8) Evidence Relied Upon

6,735,267	ORII et al.	5-2004
5,068,082	UEDA et al.	1-1991

5,229,068 JOHANSSON et al. 7-1993

(9) Grounds of Rejection

The following ground(s) of rejection are applicable to the appealed claims:

Claims 21-26 and 28-32 are rejected under 35 U.S.C. 103(a) as being unpatentable over Orii et al. in view of Ueda et al. and Johansson et al.

Orii et al. teach a structure that encompasses the basic concept of the current application, i.e., a fuel bundle having water passages with circular or square cross-sections located either centrally or proximal to the center. In particular, Fig. 15 is identical to the elected (see response dated 8/9/2004) embodiment that is described by the claimed (claims 21, 29 and 30) features except that there is no distinction in Orii et al. between short- and intermediate-length rods, and that the rods in a mirror-image long the center line are pairs rather than triplets. That is, Fig. 15 shows the following features of a fuel bundle for a boiling water reactor:

- a generally square, hollow tube having four sides which are configures as sides of the bundle,
- a pair of water passages located adjacent to a longitudinal centerline of the tube so as to extend centrally through the tube, the pair of water passages supported by one or more rod supports,
- a first part-length rod group including two part-length fuel rod subsets in a mirror-image along the centerline between the two-water passages, each subset further comprising two part-length fuel rods
- a second part-length rod group including four pair of part-length rods, each part-length rod pair centrally located in the outermost row or column of the 10x10 matrix adjacent a corresponding one of the four sides of the tube.

Orii et al. also teach that the 9x9 rod matrix (claims 31 and 32) is an established fuel assembly concept (col. 1, line 31). The deficiencies of Orii et al. are clearly acknowledged above, and there is no suggestion in the appealed rejection that Orii et al. anticipate the claimed fuel bundle.

Ueda et al. show that it is a well-known and advantageous expedient in the art to provide certain groupings of part-length rods, particularly a 3-rod subgroup (Fig. 19) adjacent a water passage. Ueda et al. also teach a design that places relatively shorter part-length rods (P_2) closer to the center of the fuel bundle and relatively longer part-length rods (P_1) toward the periphery of the fuel bundle (Fig. 25 B). This is considered a teaching regarding the usefulness and applicability of short-length and intermediate-length rods in optimizing fuel bundle performance. It is also a teaching relevant to rod positioning.

Johansson et al. teach that the addition of part-length rods lowers the pressure drop, thereby improving critical power. Note that reactor "shutdown" refers to the state of the reactor when it is subcritical (not producing sufficient neutrons to sustain fission chain reactions) by at least a margin defined in the reactor's technical specifications – i.e., "shutdown margin" is understood in the nuclear art to be a metric of criticality and power. Some particularly relevant teachings of Johansson et al. include the following:

> "Numerous advantages result from the part length rod construction. Improved cold shut down margin enables fuel to be designed with reduced amounts of burnable absorbers such as gadolinium. The tendency of the fuel bundle in the reactor to produce plutonium at the top of the bundle from resonance neutron capture in uranium 238 is reduced. The ***void overlying the part length rod*** has an increased vapor fraction with the result that the full length rods adjacent the voids have an increased liquid fraction. Further, the pressure drop in the upper two phase region of the fuel bundle is reduced. This being the case, the fuel bundle enjoys increased stability from thermal hydraulic and nuclear instabilities" (col. 2, lines 3-15; emphasis added).

While Appellant's brief has not particularly discussed claim 28, it should be clear from the prior art that it is inherent to fuel bundles including part-length rods that there be voids at the end of the shorter rods (see Ueda et al., Fig. 25A).

The number of part-length rods and the degree (i.e. fraction or fractional range) (claims 22-26) to which they are part-length is therefore a matter of optimization within prior art conditions or through routine experimentation (See MPEP § 2144.05 II.A). The concept of including part-length rods in a fuel assembly in order to modulate shutdown (as defined above and discussed in Johansson et al.) is well-known (also see Ueda et al., col. 12, line 65), and an optimization of a presently disclosed device is not considered patentably distinct from the original device.

Additionally, Appellant has not shown how the 3-rod group is functionally distinct from the 2-rod group, or that it is not an obvious variant. As stated on page 3 of the Office action dated 2/13/2006, the reason this distinction is relevant is that duplicating a part – in this case, adding a third rod – is not considered to impart patentability to a structure where the duplication of the part results in an expected duplication of the known effect. In the present case, the part-length rods are included for the purpose of improving shut-down margin, which is a motivation common to the referenced prior art. Modulating shut-down margin is the known effect achieved by duplicating the part. See *In re Harza*, 274 F.2d 669, 124 USPQ 378 (CCPA 1960). It would have been obvious to one skilled in the art at the time of the invention to combine the aforementioned teachings in order to provide the benefits that are the disclosed objects of all of the referenced prior art, particularly an improved shutdown margin.

(10) Response to Argument

Response to VII.A.

In section VII.A. of the appeal brief, Appellant submits that Orii et al., singly or in combination with Ueda, fail to teach or suggest the claimed fuel bundle for a boiling water

reactor. Appellant then specifically points out the deficiencies of Orii et al., which are freely admitted by Examiner, and mischaracterizes Examiner's reliance on Ueda et al. That is, Appellant falsely claims that Examiner alleged that it would be obvious to combine the ***four sub-bundle arrangement*** as interpreted from Fig. 19 of Ueda et al. There is no mention of such a combination in the appealed rejection. It is an incontrovertible fact that Ueda et al. teach using a 3-rod (triangular orientation) grouping of part-length rods, and positioning that grouping adjacent to a water channel. The embodiment (Fig. 19) characterized by these features attains effects for increasing effective multiplication factor at a high temperature of operation and reducing the effective (***not*** "effect of" as stated by Appellant) multiplication factor at the low temperature operation period (i.e., large shutdown margin). Examiner is not attempting to combine ***every feature*** of this embodiment with the primary reference, but rather has gleaned relevant teachings regarding the configuration and position of the 3-rod subgroup.

The test for obviousness is not whether the features of a secondary reference may be bodily incorporated into the structure of the primary reference; nor is it that the claimed invention must be expressly suggested in any one or all of the references. Rather, the test is what the combined teachings of the references would have suggested to those of ordinary skill in the art. See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981). One of ordinary skill in the art, understanding the scientific phenomena (i.e., shutdown margin as it relates to criticality) that advantageously accompany the configuration of part-length rods disclosed by Ueda et al., would be motivated to combine the teachings thereof with the disclosures by Orii et al. in order to modulate those scientific phenomena by producing a differently configured bundle. The modification resulting from this combination does not require complete rearrangement of the fuel

bundle matrix disclosed in Orii et al. Rather, employing two 3-rod groups as opposed to two 2-rod groups requires only replacing two full length rods with two part-length rods. This modification is within the purview of the skilled artisan, and is encompassed by the teachings of the cited art.

While the referenced fuel bundles of Orii et al. and Ueda et al. are different, it is misleading to state that "the two fuel bundles matrices are completely different structures" (appeal brief, p. 8). As one can see from the numerous various embodiments pictured in Orii et al. and Ueda et al., fuel bundles having various sizes, water channels and fuel rod arrangements are based on related technology and are universally subject to hydraulic and neutronic stimuli within the reactor. These embodiments, though different, are all designed to improve performance of the core based on the same physical stresses and effects associated with boiling water reactors. The differences between them correspond to varying advantages and limitations, but the teachings that can be derived from those varying advantages and limitations are applicable to fuel bundles in general.

Similarly, Appellant attempts to argue that because it is a different embodiment (Figs. 25A-D) that includes intermediate-length fuel rods, it is not technically feasible to incorporate intermediate-length fuel rods into the hypothetical obvious embodiment postulated by Examiner. This attempt is once again characterized by bodily incorporation of the features of a secondary reference into the structure of the primary reference. Examiner is not suggesting, and it is not required, to completely alter the bundle arrangement taught by Orii et al. in order to provide it with intermediate-length rods. The teaching that intermediate-length rods provide an advantage is applicable to nuclear fuel bundles in general, regardless of the number of fuel rods or the shape

of the water passages. If the various combinations ***actually*** set forth in the rejection – as opposed to those provided by Appellant's misinterpretations – ***were*** technically unfeasible, then the claimed invention would also be impossible.

Moreover, claims 21-26 and 28-32 stand rejected in view of Orii et al., Ueda et al. ***and Johansson et al.*** One cannot show nonobviousness by attacking references individually where the rejections are based on combinations of references. See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981); *In re Merck & Co.*, 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986).

Response to VII.A.1

Appellant's assertion that "Examiner ... provides no motivation for combining this embodiment [Ueda (Fig. 25A and 25B)] with Ueda Fig. 19 and Orii Fig. 15" (appeal brief, section VII.A.1) is completely false. Although one might even argue that Orii et al. and Ueda et al. provide adequate teachings to both teach and motivate the hypothetical obvious embodiment set forth in the rejection, Examiner has particularly cited Johansson et al. because of the explicit teachings it provides regarding the benefits of part-length rods. Achieving and optimizing these benefits – that is, improving critical power – is a powerful motivator in the nuclear art. It is only Appellant's gross mischaracterization of the appealed rejection, that is, the aforementioned bodily incorporation of the secondary reference, that provides a basis for Appellant to argue that improving critical power is somehow not an applicable motivation.

Also in section VII.A.1 of the appeal brief, Applicant attempts to suggest that because the "primary" objects of the prior art are different, that the skilled artisan is incapable of immediately appreciating the benefits of combining their teachings. However, careful consideration of Appellant's argument reveals several flaws. First, it is irrelevant which object is a "primary

focus" of the reference. Examiner is entitled to cite any teaching that is provided by a reference, even where those teachings are supposedly peripheral to the central problem the patented invention deals with. Second, the objects of increasing fuel utilization (burn-up) without increasing pressure loss (Orii et al.) and maintaining shutdown margin or improving axial power distribution (Ueda et al.) are both closely related each other and to optimizing reactor power. An important purpose of a nuclear reactor is to produce power. The efficiency, reliability, longevity and capacity of the reactor are interrelated and dependent upon fuel utilization, power distribution and myriad other factors affected by fuel bundle structure. No single fuel bundle structure is superior in every conceivable respect to other fuel bundle structures, and bundles of varying configurations are used in different regions of the core. Third, the burden Examiner is attempting to meet is not that by making the modifications hypothesized in the rejection, one would in fact achieve the alleged primary objects of the cited references. Rather, Examiner maintains that, based on the numerous advantages resulting from part-length rod construction, there is a reasonable expectation of success for achieving improved reactor function, particularly embodied by improved shutdown margin. Indeed, there is no evidence that the invention of the instant application in fact provides improvements in performance over the cited prior. Appellant's statements regarding the need for substantial undue experimentation and destruction of the references are baseless speculation.

Response to VII.A.2

Much as Appellant charges in section VII.A.2 of the appeal brief, Examiner did search for a prior art fuel assembly using the claimed invention as a blueprint, and, after identifying deficiencies in the most appropriate art, proceeded to search the prior art for the missing

elements. However, contrary to Appellant's assertions, Examiner has identified and discussed the specific evidence of motivation to combine, which are chiefly evident in the Johansson et al. reference Appellant has avoided properly addressing. Examiner does provide additional comments regarding the duplication of parts, but these do not negate the motivations provided by Johansson et al. Additionally, the fact that adding an additional part-length rod changes the characteristics of shutdown margin (SDM) is not evidence that the duplication of parts is nonobvious. In fact, only if the SMD did ***not*** change after adding a part-length rod or changed in an aberrant way would there be evidence of unpredictable effects and a basis for challenging the obviousness of duplication of parts. Appellant has failed entirely to address the motivations that are actually provided in the appealed rejection.

Response to VII.A.3

In section VII.A.3 of the appeal brief Appellant again mischaracterizes the rejection by stating, "Examiner has not adequately supported the selection and combination of Orii and Ueda." The motivations provided by Johansson et al. are an integral part of the rejection. These teachings regarding the benefits of part-length fuel rods, including that the improved shutdown margin they provide allows for even further benefits are not "unsupported in Orii or Ueda" (appeal brief, p. 12) and are fully applicable to the other references. As to explaining the motivations that are clearly set forth, Examiner judged it extraneous to actually give reasons why improving reactor shutdown margin is beneficial enough to motivate the skilled artisan to use widely available technology to achieve it. This judgment is based on disclosures in the present specification, including the following statements fond in the "Related Art" section:

> "The disadvantage of using 100% full-length fuel rods is that reactor shut-down margin is not optimized" (¶ [0004]),

> "Shut-down margin is therefore a sufficient percentage of trapped neutrons compared to fissioned neutrons which prevents criticality. Shut-down margin is commonly enhanced by distributing a quantity of part-length fuel rods in each bundle" (¶ [0004]),
>
> "It is also known to distribute two lengths of part-length fuel rods, having short-length fuel rods positioned in each corner of the channel body, and intermediate-length fuel rods arranged generally about the interior water passages" (¶ [0005]),
>
> "The known configurations of part-length fuel rods in a fuel bundle therefore do not achieve optimum reactor critical power and/or shut-down margin" (¶ [0006]).

Clearly, it is commonly understood in the art and by Appellant that improving reactor critical power and shut-down margin are powerful motivators. ***Additionally, these disclosures characterize the invention's alleged contribution over the prior art as an optimization of the known strategies of using short- and intermediate-length fuel rods, just as argued in the rejection and supported by Johansson et al.*** It must be recognized that any judgment on obviousness is in a sense necessarily a reconstruction based upon hindsight reasoning. But so long as it takes into account only knowledge which was within the level of ordinary skill at the time the claimed invention was made, and does not include knowledge gleaned only from the appellant's disclosure, such a reconstruction is proper. See *In re McLaughlin*, 443 F.2d 1392, 170 USPQ 209 (CCPA 1971). The motivations cited by Examiner are clearly set forth in the prior art, and are not solely gleaned from the instant application, where they are furthermore admitted as being known.

On page 13 of the appeal brief, Appellant provides the *first* substantive comment regarding Johansson et al. It is the conclusory statement that, "Johansson is not relevant to any motivation for combining the part-length rod arrangement in two of Ueda's 4X4 sub-fuel assemblies in Fig. 19, with Orii's 10X10 fuel assembly having two central circular water

channels." The reason provided for this erroneous conclusion is that "critical power is related to boiling transition during actual critical reactor operation, and not to shutdown margin." In view of the aforesaid definition of shutdown margin, this reason is nonsensical. ***Critical reactor operation and shutdown margin are interrelated concepts*** (see specification, ¶ [0006]). Shutdown margin is a metric of criticality and power defined by the reactor's technical specifications, and is relevant during actual critical reactor operation. As stated in Johansson et al., "Improved cold shut down margin enables fuel to be designed with reduced amounts of burnable absorbers" (col. 2, lines 4-6). Burnable absorbers affect neutron flux within the reactor, which in turn affects criticality and power. This is only one, non-limiting example of why it ***is*** clear to anyone skilled in the art how the teachings of Johansson et al. are relevant to Examiner's stated motivation.

Response to VII.B.

With regard to section VII.B of the appeal brief, Examiner fully admits that the features of claims 23, 24, 26 and 32 are only implicitly taught by the references. The features of claim 30 – a 10X10 matrix having a particular arrangement of intermediate-length rods – are encompassed and motivated by the teachings of Orii et al., Ueda et al. and Johansson et al. as set forth above. Examiner's statement that the number of part length rods and the degree (i.e., fraction or fractional range) to which they are part-length is a matter of optimization within prior art conditions or through routine experimentation ***is not unsupported***. It is based on teachings provided by Johansson et al. (Office action dated 2/13/2006, p. 4). For example, Johansson et al. teach that the void overlying the part length rod has an ***increased vapor fraction*** (col. 2, lines 9-10). One reason it did not appear necessary to discuss this support at length in the rejection is

Appellant's own statement in the specification: "To prevent steam-venting, the length of both the intermediate-length fuel rods and short-length fuel rods ***can be optimized over a range of lengths***" (¶ [0010], emphasis added). The hydraulic and neutronic phenomena that may be modulated by optimizing the lengths of the part-length rods are therefore established as known. It should therefore go without saying that where a conventional 9X9 matrix is used instead of the also conventional 10X10 matrix, that the number and arrangement of part-length fuel rods would be optimized accordingly.

The prior art conditions that the relevant features may be optimized within are those known concepts presented in the excerpts reproduced from the "Related Art" section of the specification above, which are also disclosed in the prior art. That is, it is known to use short- and intermediate-length rods to modulate critical power, which is affected by numerous known factors. While Appellant states in the specification that the configurations in the prior art are not optimized, Appellant fails to establish that the claimed invention is optimal. Appellant also fails to acknowledge as old the concept of placing relatively shorter part-length rods closer to the center of the fuel bundle and relatively longer part-length rods toward the periphery of the fuel bundle (Ueda et al., Fig. 25B). This is a general condition in the art relevant to the features recited in claims 30 and 32.

Appellant's own disclosure regarding the optimization of the fuel rod lengths calls into question the statement on page 14 of the appeal brief that designing a fuel bundle as claimed "can take up to several man-years of effort." This statement is mere speculation that mischaracterizes the state of the art. First, an extended duration of experimentation alone does not render the optimized feature a novel invention. Second, the optimization of bundle

arrangements, pin enrichments, refueling schedules, etc. is currently substantially expedited by widely available computer simulation technology. The actual expenditure associated with "several man-years of effort" is therefore not necessarily undue.

As to the applicability of the cited case law, Examiner disagrees with Appellant. The fact that the case law is applicable to temperature or concentration ranges is not evidence that it is not applicable to length ranges. As one can see from the following passages:

> "[W]here the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation." *In re Aller*, 220 F2d 454, 456, 105 USPQ 233, 235 (CCPA 1955), and
>
> "The normal desire of scientists and artisans to improve upon what already generally known provides the motivation to determine where in a disclosed set of percentage ranges is the optimum combination of percentages." *In re Hoeschele*, 406 F.2d 1403, 160 USPQ 809 (CCPA 1969),

the crucial issues are whether the teachings upon which the routine experimentation is based are known, and whether optimum ranges can be determined through the routine experimentation. Appellant admits in the specification that such is the case in the present invention, and the prior art supports this contention.

The "general conditions" are related to the state of the art, rather than the specific claimed range. If the length ranges disclosed in the prior art were within the claimed ranges, there would be grounds for ***anticipation*** as set forth in MPEP § 2144.05.I. ***Optimization***, in contrast, requires that a particular parameter (not temperature or concentration only), be recognized as a result-effective variable (MPEP § 2144.05.II). The length and number of the part-length rods are clearly result-effective variables, which achieve varying degrees of the benefits disclosed by Johansson et al. as they are varied. Different lengths and combinations of different lengths will affect fuel utilization, shutdown margin and coolant behavior differently, but largely predictably.

It is Appellant's response to this carefully reasoned argument that is mere hand waving and hence improper. Appellant has not shown criticality of the claimed rod length ranges or arrangements, and indeed there is none, as the claimed rod length ranges and number of partial-length rods achieve only predictable and expected changes in reactor performance. Appellant has also failed to show that the art teaches away from the claimed invention. In fact, the motivations on which the disclosed optimization (¶ [0006] and [0010]) is based are the same as those applied for years in the nuclear industry. Given these failures and the fact that the cited references and admissions by Appellant show that it is known to have short- and intermediate-length rods positioned advantageously in fuel bundles, the claimed invention is not patentably distinct from the prior art.

(11) Related Proceeding(s) Appendix

No decision rendered by a court or the Board is identified by the examiner in the Related Appeals and Interferences section of this examiner's answer.

For the above reasons, it is believed that the rejections should be sustained.

Respectfully submitted,

Alexandra Awai

JACK KEITH
SUPERVISORY PATENT EXAMINER

Conferees:

Jack Keith (SPE)

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FOR TOM BLACK